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ABSTRACT

Values are taught in every lesson; however, in mathematics classes this seems to be implicit rather than explicit. This paper discusses an approach to explore the values that teachers teach in mathematics sessions and outlines methodological issues encountered in researching these values. First, ways of researching values is discussed and worked with individual teachers using a cycle of a preliminary interview, a classroom observation, and a post-observation debriefing interview on the same day. Overall the methods chosen for the exploration seem to be useful in collecting what appears to be rich data for insights to be gained as to what values teachers can plan to teach and what values remain implicit in their teaching. One crucial area that has emerged is finding a common language with which meaningful dialogue can occur. One of the issues that remains is to understand more fully the language that teachers use as they try to share with researchers and each other what values they wish to teach. (Contains 14 references.) (ASK)

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Methodology Challenges and Constraints in the Values and Mathematics Project

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We think we know the way:

But the road to follow is in the detail

Values are taught in every lesson. However in mathematics classes this seems to be implicit rather than explicit. This paper outlines methodological issues encountered in researching the values teachers teach. One crucial area that has emerged is finding a common language with which meaningful dialogue can occur.

Values in mathematics education are the deep affective qualities which education aims to foster through the school subject of mathematics (Bishop, FitzSimons, Seah & Clarkson, 1999). They are a crucial component of the classrooms affective environment. Although values teaching and learning inevitably happen in all mathematics classrooms, the teaching of values appears to be mostly implicit. Thus it is likely that teachers have only a limited understanding of what values are being taught and encouraged. Values are rarely considered in any discussion about mathematics teaching. A casual question to mathematics teachers about the values they are teaching often produces an answer to the effect that they do not believe they are teaching any values. Unless specifically asked to do so, we have yet to find a teacher who plans what values will be taught in a particular lesson or sequence of lessons. This is in contrast to the preparation undertaken for content, and perhaps the particular teaching methodologies to use. With this scenario of teachers not fully understanding what they do in the act of teaching, it is a challenging situation to attempt to observe, measure, or even discuss such implicit aspects of their action. Hence the challenge in this project was not only to decide what were key questions to ask, but to develop an appropriate mix of investigative strategies that would help us gain some insight into this area of teaching.

How do you research values?

There are a number of possible strategies that needed to be considered. At least two categories are 'real time' strategies and 'simulated' strategies. Within these there are a number of possibilities:

- *Simulated*

- 'In-basket method'; eg. Letter from parent, memo from HoD
- Case studies
- Written descriptions of teaching episodes (written anecdotes of situations when value-decisions may play a role)
- Video clips
- Still photographs

- *Real-time*

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- Classroom observations; field notes and/or video and/or audio taped
- Staffroom observations; field notes
- Faculty/Department observations; field notes
- Teacher portfolios
- Individual interviews
- Group interviews; focus groups, professional development sessions

The methodology we have used is rather traditional in some aspects. The approach adopted was to work with individual teachers using a cycle of a preliminary interview, a classroom observation, and a post-observation debriefing interview on the same day. This cycle is repeated with the same teacher two or three times. The classroom observations are video taped, and the interviews audio taped. We analyse the audio tapes but not the video tapes. The video tapes are used solely to capture episodes from the classroom to stimulate discussion with the teacher during the debriefing interview. If possible, when transcripts of the interviews are available, another reflective interview is held some months after the classroom observations.

Using this strategy we are looking to see whether teachers can articulate their own intended values, and whether they can implement these in their classroom. Hence in the preliminary interview we ask teachers to nominate values that they suspect will arise during the lesson we will be observing. In other words the teachers have the opportunity to plan for the teaching of particular values. During the observation lessons we look specifically for these values nominated by the teachers. We are not nominating particular values and asking teachers to teach those. Nor are we choosing a methodology that has us observing lessons in a rather random way, hoping to observe values that happen to be taught. We are keen to make the process open for the teachers and to see whether they actually teach the values which they have nominated. We believe this approach is rather novel in education research. It not only asks teachers to reflect on their teaching behaviour and to say what values they are teaching; it also asks for authentication of the teacher's analysis by seeking to observe the stated behaviour in a classroom situation devised by the teacher. So before the observation lessons began, the teacher was asked to hand the researcher/observer a brief lesson plan which has the normal flow of content, the teaching strategies planned to be used, but also a listing of the values the teacher will be seeking to teach in the lesson.

In the observation lessons the researcher takes particular interest in the critical decision points during the teaching. These critical decision points are times in the flow of the lesson when the teacher needs to make a decision that will influence the direction the lesson takes. It seems to us that it is in those decision times that the influence of values that the teacher is teaching may be most clearly evident. Clearly at these decision points, values are not the only influence. School policy, the physical situation within which the lesson takes place, and so forth will also play at times a more dominant role than the values that the teacher may be teaching. Nevertheless, the implementation of values will also play a role in the decision making.

Prior to the commencement of the observation lesson, a video camera is positioned at the back of the classroom with a wide angled view capturing an area of the room where it is anticipated the teacher will mainly be during the lesson. Little attempt is made during the lesson to follow the teacher with the video. This means the researcher can concentrate on taking field notes. As well little attention is drawn to the camera by continually attending to it.

In the post observation interviews the video tapes become the central prompting device for both the researcher and the teacher. We hoped that the teacher would be able to remember points in the lesson at which they thought they were teaching the identified values. This has proved to be the case. They use the video tape to help prompt their memory and elaborate on these episodes for the researcher. As well the researcher has noted points at which values teaching seemed to be occurring, and the use of the tape has helped the teacher recall these episodes. The aim of the debriefing interview is for the teacher and researcher to come to a shared agreement on some particular examples of when and how values teaching occurred in a particular lesson.

An Issue of Language

When piloting various data gathering techniques, and gathering some support from interested teachers, perhaps the crucial finding from an analysis of our field notes taken during these sessions was the lack of an appropriate and shared vocabulary to discuss the types of values in which we are interested; that is values based in mathematics and mathematics education. The language involved in this investigation, and indeed in the transmission of values implicitly or explicitly in the classroom, is crucial. Indeed, this project essentially revolves around finding ways to make values linguistically explicit. This of itself will not lead to explicit values teaching. Rather, it will lead to a shared understanding between teachers and researchers. Because of the nature of language, a cultural artefact itself, one can never be sure of course that certain words do capture a shared meaning, or value in this case. Both teachers and ourselves have struggled to find appropriate language so that these ideas - which are still being formed, reformed and refined - can be communicated in a positive manner.

As a research team we have always been conscious of this problem. In the research literature there have been many attempts at linking teachers' beliefs to their teaching of mathematics (McLeod, 1992; Southwell, 1995; Thompson, 1992; Tirta & Gondoseputro, 1999). However the results of this research are equivocal. Although some studies purport to find clear linkages, others do not. As Neuman (1997) suggests, subsequent actions need not necessarily correspond with stated intentions. A number of studies on beliefs were in the nature of self-reports, but there appears to have been few attempts to follow up these self-reports to see whether the teachers actually act upon their beliefs. For a variety of reasons we do not always act on our beliefs in certain situations. We wondered whether this explained some of the confusion in the literature. Hence one of the meanings we bring to 'values' in this study is the notion that 'values are beliefs in action'. That is, the values that teachers are

teaching in the mathematics classroom are not only beliefs the teacher holds, but their behaviour in the classroom actually point to these beliefs. These are what we call 'values'. But this in itself is too simplistic, but it does give us a touchstone to work from. In our own discussions, and in the professional development sessions we have conducted, various notions are clearly embedded in this notion of 'value'. We return to these ideas later.

In a very real sense, this problem of language was inescapable. As noted above, a central feature of this project is to explore together the linguistic framework that we as researchers and teachers use to try and share our understanding of the values that they teach in their mathematics classrooms. Thus it was decided that a lexicon to be made available to teachers involved in the project was neither possible nor practicable.

Some Other Issues

'Conflicting values' was another issue that has arisen in our discussions with teachers. When contemplating the different situations it became clear that teachers are in difficult situations at times. For example, a teacher wishing students to develop an investigative stance to a project, and the students themselves, may wish to achieve closure at different points. In resolving this issue it may be that the teacher will need to draw on another set of more deep-seated values to resolve the conflict. On the other hand, the situation may be resolved from other sources, for example the submission dates set by an external examining body over which the teacher has no control.

A common theme that we have also detected has been the presence of a certain amount of apprehension from the teachers. The subject of 'values' seems to immediately provoke in many teacher notions of judgement and finding fault. This may be a comment on our society, but it is an aspect of this project that needs to be taken very seriously. This in part is a language issue, but also means that we need to be scrupulous in respecting the teachers' personal value systems.

Demonstrative Results

To demonstrate some of the points made above, we tabulate some of the raw data from our investigation so far. In Table 1 are some of the notions which arose during the piloting of this project. Although we had set out purposefully to discuss with teachers values that they might see coming from both 'mathematics the subject' and from 'the art of teaching mathematics', the general societal meanings associated with 'value' also came through strongly (see column 1 of Table 1). This is no surprise. It is useful from an academic point of view to box up ideas. However in the real world of the classroom such boxes are seen for what they are, mere albeit useful artefacts for a particular study. In the first listing of these observations, we had used nouns to express a number of the 'mathematical educational values'. In discussion with teachers, colleagues and our own reflections we have decided to try and use expressions that emphasize action. After all we try to observe the presence of the value by the behaviours that seem to point to them (see column 2 of Table 1).

Table 1: Aspects of meaning either used in or arising from discussions with teachers

General meanings of 'value'	Mathematics educational values
To value is:	Clarifying
· to command	Looking for flexibility
· to praise	Being consistent
· to heed	Being open minded
· to regard	Displaying persistence
A value is:	Being accurate
· a standard	Efficient working
· a thing regarded to have worth	Systematic working
· a principle by which we live/act	Having enjoyment
· a standard by which we judge what is important	Organizing effectively
· something we aim for	Showing creativity
· qualities to which we conform	Conjecturing

As noted above, teachers were asked to nominate values they planned to teach in the observed lessons. Tables 2a and 2b show

the nominated values (plain type) that two teachers, 'Jack' and 'Jill' proposed to teach in 4 lessons. Jack and Jill were two experienced teachers that had shared a multi aged class (years 2 through 6) of 40 odd students for some six years. They teach is a double portable classroom set up in an open planned manner. Their basic mode of teaching in the four observed lessons was based on discussion, openess, and involvement. For each lesson observed one of the pair worked with the grade 5 and 6 students. The other teacher was mainly occupied with other tasks, although for some of the time did interact with the students when they were in small groups.

It is not the purpose here to analyse in depth the values that have been nominated, but simply to make some observations. First the two teachers were intrigued with the idea of planning for the values that they would be teaching. They indicated planning in this way was something they had never done before, in fact they had never thought of doing this before, although they readily acknowledged that they were always teaching values. It was clearly something that they were pleased to give some attention to and thought it would be an excellent broadening activity for them as teachers. Secondly, various behaviours of the teachers during the lessons were interpreted by the observer as pointing to the different nominated values. Hence it seems clear that this observation strategy can work. Thirdly there were some other values that the observer noted which had been not nominated by the teachers. The teacher also agreed with these observations during the post observation interview. It seems that even though teachers might plan carefully for the values they will explicitly teach, there are other values that they still teach implicitly.

Table 2a: Values proposed and taught by 'Jack' in two mathematics sessions. Plain type shows the 'values' nominated by the teacher, and the italics shows 'additional values' observed by the researcher.

Jack 1

- valuing children's existing (prior) knowledge
- valuing their approximations and attempts
- expecting engagement and participation
- a high value put on mathematical thinking
- expecting an enquiry approach by students
- hoping for children to make wider mathematical connections
- valuing the use of existing mathematical knowledge to solve new problems
- value social connections and cooperation as the best way to learn
- value self-reliance and self confidence (I'm interested in the interplay between this and the previous point)
- high value put on following up, perseverance and completion/closure with the problem
    - *Reflection*
    - *New strategies*
    - *Openness*
    - *Independence*
    - *Accurate recording*
    - *Respect for managerial authority*
    - *Clarity of communication*

Jack 2

- valuing children's prior knowledge
- value ("privilege") changes or growth in mathematical knowledge since we started this unit on volume
- value mathematical thinking and explanation (even if incorrect) over rote/rule-based responses
- expect engagement and participation
- expect and value a range of problem-solving strategies
- expect and value social connections/cooperation during the work
- expect children who differ or disagree with the group to "stand up for themselves" - confidence
- expect tolerance of others having different/diverse strategies and answers
- high value put on persevering and completing the tasks (possibly after the session) - closure
    - *Proving*
    - *Justifying*
    - *Clear communication*

Table 2b: Values proposed and taught by 'Jill' in two mathematics sessions. Plain type shows the 'values' nominated by the teacher, and the italics shows 'additional values' observed by the researcher.

Jill 1

- participation and engagement
- connected, extended investigation
- build on existing knowledge
- talking about a problem or explaining helps to scaffold and clarify thinking of self and others
- children's own findings are important in developing mathematical understandings
- difficult mathematical concepts can be explored in a familiar context
- working with others helps develop mathematical connections and understandings
- perseverance
- sharing helps others "see"; hence a variety of responses is valued
- there are times when teachers need to "model" what they expect children to see or understand
- teacher is the "guide" (in this case)
    - *Clarity in communication*
    - *Closure*
    - *Logic*
    - *Inclusivity*

Jill 2

- build on existing mathematical understanding
- engagement and participation
- graphic representation
- linking mathematics to a "real" object
- finding out within a constructed framework eg. by using scaffolding/enquiry
- mathematical debate
- mathematical experience (doing it)
- experimentation
- social interaction to support the construction of mathematical understandings
- children as teachers
- inclusivity
- clarity of communication
- completion of work
- children explaining mathematical understanding
    - *Reflection*
    - *Estimating/modelling*
    - *Proving*
    - *Confidence*
    - *Judgement of quality*

A couple of other useful observations could be made. Although the teachers were asked to plan and articulate those values that were sourced in mathematics and/or the teaching of mathematics, there were some more seemingly general educational values that were listed. These were so important to these teachers, whether they were teaching mathematics or not, they needed to be listed. Some of these were; 'expecting engagement and participation', 'value self-reliance and self confidence', 'expect and value social connections/cooperation during the work', and 'participation and engagement'. A further observation was that some of the implicit values that were observed by the researcher in the first lesson, the teacher chose to list for the second lesson; for example 'clarity of communication'. Finally, although there was a large overlap of values between these two teachers, there were also differences.

It was always planned and hoped that parallel projects would evolve overseas; it was expected that different cultures might well have an important influence on how and what values are taught in mathematics classrooms, and how one should try to investigate them. Colleagues in Taiwan, led by Professor Fou-Lai Lin, have developed such a project (Lin & Chin, 1998) arising from our initial contact in 1996 with a visit by Clarkson to Taiwan. Communications have continued with informal meetings at conferences, sharing of papers electronically, and joint symposium (for example, Chang, 2000; Chin & Lin, 1999a; Chin & Lin, 1999b; Leu, 1999; Leu & Wu, 2000; Wu & Lin, 1999). We have found many aspects of their project fruitful to think about. However, we wish to highlight one particular aspect of their project that has made us reflect more deeply on our own methods.

This aspect concerns the relationship between the members of the Taiwan research group and the teachers with which they were working. In two different situations it seems that because of a shared religious/spiritual view of life, a teacher and fellow researcher were able to come to a deeper shared insight into the questions of value teaching than might have been otherwise possible. It so happens that Clarkson had taught for some years in a tertiary institution with teacher 'Adam'. Hence in some ways it is not surprising that Adam's nominated values (see Table 3) might seem to be expressed in a more 'clipped' style than those of Jack and Jill, since he and Clarkson already shared a joint language on many educational issues. Adam was teaching a grade 8

group of students. The classroom was set up with tables in a traditional rectangular grid. It was a general teaching room of the school. Adam, a very experienced teacher, with many years of working in the tertiary sector as well, was clearly in managerial control. Of the values he planned to teach, it is interesting to note that like Jack and Jill not all values in the list were sourced in mathematics or the art of teaching mathematics. However most values planned to be taught by Adam had a clear link to mathematics.

The final matter of methodology to reflect on is how we will analyse the diverse range of material that we have collected from the classes so far observed. As a start we plan to use a structure that Bishop (1988) has proposed (Table 4). Some of the teacher nominated values would seem to fit easily into various sub categories of this structure. However, not surprisingly, other nominated and observed values will fall outside of this structure since we are not only interested in values that are derived from mathematics, but also from the art of teaching mathematics.

Table 3: Values proposed and taught by 'Adam' in three mathematics sessions. Plain type shows the 'values' nominated by the teacher, and the italics shows 'additional values' observed by the researcher.

Adam 1

- Cooperation - sharing of ideas for growth
- Valuing the individual by taking "this" approach to teaching
- Showing maths as a tool - utilitarian
- Clear communication through:
    - effectiveness of graphing
    - verbal in small groups
    - written summaries of students
- Systematic approach - logic
    - *Clarifying - verbal communication*
    - *Encourages participation*
    - *Inclusiveness*
    - *Logic*

Adam 2

- Cooperation
- The individual
- Maths as a tool
- Clear communication
- Systematic approach
    - *Self-discipline - perseverance*
    - *Reflection*
    - *Inclusiveness*
    - *Reality of mathematics*
    - *Logic - sense making*

Adam 3

- Cooperation - sharing of ideas
- Valuing the individual
- Showing maths as a useful tool
- Clear communication through different modes of:
    - writing
    - graphing
    - verbalisation
- Systematic approach - logic
    - *Closure*

Table 4: Mathematical values (after Bishop, 1988, pp.60-81)

1a Rationalism	
reason hypothetical reasoning logical thinking	explanation abstractions theories
1b Objectivism	
atomism materialism determinism analogical thinking	objectivising concretising symbolising
2a Control	
prediction knowing security	mastery over environment rules power
2b Progress	
growth cumulative development of knowledge generalisation	questioning alternativism
3a Openness	
facts articulation demonstration verification	universality individual liberty sharing
3b Mystery	
abstractness unclear origins dehumanised knowledge	wonder mystique

Summary

In this paper we have discussed an approach to explore the values that teachers teach in mathematics sessions. Overall the methods chosen for the exploration seem to be useful in collecting what appears to be rich data for insights to be gained as to what values teachers can plan to teach, and what values remain implicit in their teaching. One of the issues that remains is to understand more fully the language that teachers use as they try to share with researchers and each other what values they wish to teach.

Later we plan to use a similar methodology to pursue another aim of the investigation. The major change to the methodology will occur in the preliminary interview. We will no longer be asking teachers to nominate values that they normally teach, and from this broad set specify some which they suspect will be given particular emphasis in the coming observation lesson. Rather we will be asking teacher to implement some value(s) in the observation lesson that they do not normally teach, but on reflection they think they should be teaching. This change of emphasis will give further insight into how much control teachers may have over their teaching of values. Later again we hope to extend our research to incorporate both teachers and students and seek evidence for any learning or modelling by students of the values the teacher is emphasising.

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